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## Taxonomical and molecular evaluation of *Apochima* Agassiz in East Turkey, with a description of a new genus (*Lepidoptera*, *Geometridae*, *Ennominae*)<sup>1</sup>

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**Abstract:** Taxonomical and molecular evaluation of *Apochima* Agassiz in East Turkey, with a description of a new genus (*Lepidoptera*, *Geometridae*, *Ennominae*). *Misc. Pap.* 169: 1-13, 1 Table, 27 figs., 1 map.

From the taxonomical, morphological and molecular standpoints, the cases of two species, *Apochima flabellaria*, and *diaphanaria* are discussed. As a result of these, a new genus, *Bellachima* **gen.n.** is established here. Consequently, two new combinations are proposed. Following structures of these species are studied and illustrated here for the first time. Lateral setae over the compound eyes, protruding frons, shape of vertex, male of antenna its segmentation, pubescence, shape of epiphyses on fore-tibia, spurs on hind-tibia, tympanal organs, male and female genitalia of *Bellachima diaphanaria*. Separately, *Bellachima diaphanaria* is re-described. Faunistically, new provincial records are mentioned.

**Keywords:** Turkey, *Lepidoptera*, *Apochima*, *Bellachima*, *flabellaria*, *diaphanaria*, taxonomy, morphology, fauna, mtCOI, description, new genus.

The family *Geometridae* is represented by 683 species in Turkey (Info-system of the Cesa).<sup>3</sup> These species are currently belong to the 215 genus group taxa (Koçak & Kemal, 2015). The European members of the family are classified under 7 subfamilies (Lepiforum, 2018). The members of the subfamily *Ennominae* are predominantly nocturnal in Turkey. However, the following species are also recorded by day: *Pseudopanthera macularia*, *P. syriacata*, *Boudinotiana notha*\*, *Abraxas grossulariata*, *Heliomata glarearia*, *Chiasmia clathrata*, *Isturgia murinaria*\*, *Enanthyperythra legataria*, *Siona lineata*, *Aspitates gilvaria*. Among the species, marked with “\*” above, the adult moths fly either in late autumn, or in early spring. On the other hand, the members of the genus *Apochima* are nocturnal and may be considered in the winter moth group (cf. Yamamoto & Sota, 2007).

<sup>1</sup> After the announcement, this is the authors' first taxonomical and molecular study. *Vide* Announcement: Cesa News 150 (2017): 1. <https://archive.org/details/TextscentreForEntomologicalStudiesAnkaraCesaNewsNr.150>

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<sup>3</sup> <http://www.cesa-tr.org/Infos.htm>

The genus *Apochima* was proposed by Agassiz in 1847 as a replacement name for *Apocheima* Herrich-Schäffer, 1838, which was preoccupied by *Apocheima* Hübner, [1825]. *Apochima* Agassiz, 1847 is currently used as a valid genus name of five species, *diaphanaria* Püngeler, 1904, *flagellaria* Heeger, 1838, *excavata* Dyar, 1905, and *juglansaria* Graeser, 1888, and *praeacutaria* Inoue, 1976 in the whole Palaearctic.

The type-species of *Apochima* Agassiz is *Amphidasis flagellaria* Heeger, 1838, by monotypy. The genus contains three invalid synonyms, i.e., *Apocheima* Herrich-Schäffer, 1838, *Zamacra* Meyrick, 1892, and *Acanthocampa* Dyar, 1905 (Fletcher, 1979). The first one is preoccupied; therefore it is invalid. The second one with the type-species *Amphidasis flagellaria* Heeger, 1838 is junior objective synonym of *Apochima* Agassiz, 1847. The last generic name *Acanthocampa* Dyar, 1905 was established for the species *Acanthocampa excavata* Dyar, 1905, which is described from Japan and found later in Korea (Sung-Soo, *et al.*, 2016). The species *Acanthocampa excavata* Dyar, and *Amphidasis flabellaria* Heeger are currently considered congeneric. On the other hand, *Acanthocampa* Dyar, 1905 is preoccupied by *Acanthocampa* Packard, 1902 (*Saturniidae*); therefore it is invalid. This name is also junior synonym of *Apochima* Agassiz, 1847. Finally, the fourth and fifth *Apochima* species, *juglansaria* Graeser, 1888 and *praeacutaria* Inoue, 1976 are confined to Far Eastern Russia (Ussuri) and Taiwan, respectively. No generic name was established for these species so far. They are currently considered as *Apochima* species subjectively.

Taxonomic synopsis of the genus *Apochima* Agassiz with brief explanations the status of the names used is given below:

### ***Apochima* Agassiz, 1847**

Nomencl. zool. (Index univ.): 29.

Type-species: *Amphidasis flagellaria* Heeger, 1838.

<http://zoobank.org/NomenclaturalActs/41AB1D16-7480-4599-BFCF-07A716FB1468>

= *Apocheima* H.-S., 1838 nec *Apocheima* Hbn., [1825]

= *Zamacra* Meyrick, 1892

= *Acanthocampa* Dyar, 1905 nec *Acanthocampa* Packard, 1902

### **valid genus name**

**invalid, junior homonym**

**invalid, junior synonym**

**invalid, junior homonym**

As to the species of *Apochima* Agassiz in the West Palaearctic, two species occur in the region, i.e., *Apochima flabellaria* (Heeger, 1838), and *Apochima diaphanaria* (Püngeler, 1904). These species are briefly mentioned below:

### ***Apochima diaphanaria* (Püngeler, 1904)**

*Zamacra diaphanaria* Püngeler, 1904, *Dt. ent. Z., Iris* 16: 295, pl. 6 fig. 14. Type ♀: [Turkmenistan]: "Aschabad".

### ***Apochima diaphanaria* ssp. *rjabovi* (Wehrli, 1936)**

*Zamacra diaphanaria* ? an sp.n. *rjabovi* Wehrli, 1936, *Mitt. münch. ent. Ges.* 26: 34, pl. 2

figs. 2, 6. Syntypes 6♂: [Armenia]: "Nefram"; [Türkei]: "Umg. Wan, 2500m. 24 Aug." [possibly Ereğ Mt.]

### ***Apochima flabellaria* (Heeger, 1838)**

*Amphidasis flabellaria* Heeger, 1838, *Beiträge zur Schmett.*: 6-7, pl. 1 figs. 6-11. Syntypes: [Italia]: Sicilia: Palermo.

As briefly mentioned above, Püngeler (1904) described and illustrated "*Zamacra diaphanaria*" from "Aschabad" [Turkmenistan], based upon a single female. Wehrli (1936) described 6 males from Armenia and Van Province (East Turkey) in the genus *Zamacra* as *diaphanaria rjabovi* with hesitation. Taking the descriptions of *diaphanaria* and *rjabovi* into consideration, both taxa are conspecific, as currently accepted. Both taxa were described originally in the genus *Zamacra* Meyr. As it has already been mentioned above that *Zamacra* Meyrick is junior synonym of *Apochima* Agassiz. Therefore, *diaphanaria* Püngeler is the second species in the genus *Apochima*, apart from its type-species, *flabellaria* in the western Palaearctic.

### **Short comments on the suprageneric position of *Apochima*.**

In the Lepiforum, *Apochima* Agassiz is included to the tribus *Bistonini*, together with *Apocheima*, *Lycia*, *Biston*, *Agriopis*, *Erannis* etc. Skou & Sihvonen (2015) discussed *Colotoini* (incl. *Colotois*, and *Dasycorsa*), and draw attention to the potential relationship of the *Apochimini*

in relation to the *Colotoini*. The lateral setae over the compound eyes are illustrated by Skou & Sihvonen (2015) in *Colotois pennaria* and *Dasycorsa modesta*. The presence of lateral setae in *Apochima flabellaria* is mentioned but not illustrated.

There are also very interesting information in the literature about *Apochima flabellaria* or about its affinity. For example, Meyrick (1892: 121) stated when describing *Zamacra*: “*The single species, is a development of Biston, from which is not greatly differ...*”. In 2018, in the Lepiforum, *Apochima* is classified under *Bistonini*, near *Biston*. Another example, is about the number of spurs on hind tibiae. Meyrick (l.c.) cited that posterior tibia without median spurs. That means hind tibia with 2 spurs. This information is confirmed here (Table 1). Contrary to this, Dyar (1905: 952) noted: “*Zamacra with four spurs on hind tibiae, equally developed*”.

Morphological similarities and dis-similarities between *Colotoini*, and *Apochimini* may be expressed as follows; spurs of hindtibia unequal, uncus bilobed asymmetrical, absence of gnathos, presence of lateral setae over compound eye are the similarities. *Apochimini* differs from *Colotoini* especially by the presence of horny projection on the frons. This character was first mentioned by Meyrick (1892: 101) in his descriptive key.

The validity of the tribal names *Zamacrini* Viidaleep, 1989 and *Apochimini* Viidaleep, 1989: Beljaev (2007, 2008) published a comprehensive list of the family group names in *Geometridae*. He mentioned both tribal names given Viidaleep above under the *Prosoplophini* Warren (1894), which is proposed without type-genus; therefore it is unavailable. Apparently, there is no available tribal name for the genus *Apochima* Agassiz.

When comparing the morphological features of *flabellaria* and *diaphanaria*, serious differences have been noticed by the authors both externally (head, wing shape, antenna, legs, etc.), and in the male genitalia. Morphological features of some parts of adult insect are mentioned below comparatively (Table 1).

**Table 1** - Comparisons of selected morphological characters for *flabellaria* and *diaphanaria*. \* denotes the character examined, illustrated, or expressed here for the first time.

Characters	<i>flabellaria</i>	<i>diaphanaria</i>
<b>Lateral setae*</b> (Figs. 3, 5)		
hairs of lateral setae*	longer, but scattered (Fig. 3)	shorter, regularly developed (Fig. 5)
<b>Under-eye-sclerites*</b> (Figs. 3, 5)		
shape of double sclerites*	slightly developed, lower sclerite more pointed, carina between them visible (Fig. 3)	well developed, both triangular shaped, carina invisible (Fig. 5)
<b>Other structures on head*</b> (Figs. 2, 4, 6-9)		
Hairs on protruding structures on frons*	densely and long haired (Fig. 2)	sparsely and short haired (Fig. 4)
Well chitinized protruding structures on frons*	round like crater, with a central pit; edges high and sharp, elongated at top forwardly (Figs. 6, 7)	Λ-shaped with a pit centrally; edges high and sharp, elongated at top forwardly, and also pointed at two lower location on edges (Figs. 8, 9)
lateral view at top of protruding structure on frons*	slightly concave (Fig. 7)	convex (Fig. 9)
Shape of vertex*	with two humps adjoining to median line (Fig. 6)	with two humps located at outer margin of vertex (Fig. 8)
lateral view of vertex*	elevated and pointed (Fig. 7)	flattened and convex (Fig. 9)
<b>Antennae*</b> (Figs. 10-13)		
flagellum*	thicker (Fig. 12)	thinner (Fig. 13)
number of lamellated segments*	39 (Fig. 12)	41 (Fig. 13)
hairs on lamellae*	weak, short (Fig. 10)	strong, long (Fig. 11)
<b>Wings</b> (Figs. 14-16)		
margin of hindwing	smooth (Fig. 14)	undulate (Figs. 15-16)

Characters	<i>flabellaria</i>	<i>diaphanaria</i>
<b>Epiphyses*</b> (Figs. 17, 19)		
aperture on tibia where epiphysis arises*	round (Fig. 17)	triangular (Fig. 19)
location of aperture on tibia*	towards the base at 1/3 (Fig. 17)	towards the base at 1/4 (Fig. 19)
shape of epiphysis*	broad and short; spatulate (Fig. 17)	thin, very long, sinuous terminally (Fig. 19)
ratio of length of tibia/epiphysis*	1.36	1.04
<b>Hind tibiae*</b> (Figs. 18, 20)		
number of spurs	2 (terminal) (Fig. 18)	2 (terminal), 2 (median) (Fig. 20)
symmetry of spurs	unequal, ratio of their length: 0.7 (Fig. 18)	terminal spurs: almost equal, but ratio of their length: 0.94; median spurs: unequal, ratio of their length: 0.81 (Fig. 20)
shape of spurs*	thicker and shorter, pointed terminally (Fig. 18)	terminal spurs: thin and longer, pointed terminally; median spurs rudimentary, very short and round terminally (Fig. 20)
location of median spurs*	-	almost at 1/4 distally (Fig. 20)
shape of hind tibia*	long, tubular; slender in the central portion (Fig. 18)	slightly shorter than that of <i>flabellaria</i> , very thin at base, gradually thicker towards distal end (Fig. 20)
<b>Base of abdomen and tympanal organ*</b> (Figs. 21-24)		
Basal segments of abdomen*	remarkably broader (Fig. 22)	remarkably narrower (Fig. 24)
tympanal organs*	smaller (Fig. 22)	larger (Fig. 24)
<b>Male genitalia</b> (Figs. 25, 26)		
shape of uncus*	asymmetrical (Fig. 25)	almost symmetrical (Fig. 26)
location of uncus*	slipped to the side (Fig. 25)	in the middle (Fig. 26)
shape of valva*	asymmetrical in size; almost a quarter spherical (Fig. 25)	symmetrical, different shaped with additional chitinous processes (Fig. 26)
aedeagus*	without cornutus (Fig. 25)	with a long, strongly developed cornutus (Fig. 26)

As a result of these evaluations, the following structures are first examined here for the species under discussion: Lateral setae over the compound eyes, protruding frons and shape of vertex, male of antenna its segmentation, and pubescence, shape of epiphyses on fore-tibia, spurs on hind-tibia, tympanal organs, male and female genitalia of *diaphanaria*.

## Molecular Evaluations

The dry legs of individual specimens were washed three times in 100 µL of fresh ethanol (70%) prior to gDNA extraction. Total gDNA from all specimens was extracted from femur part of legs using RED Extract-N-Amp Tissue PCR Kit (Sigma, St. Louis, MO, USA) according to manufacturer instructions.

LepF1: ATTCAACCAATCATAAAGATATTGG and LepR1: TAAACTTCTGGATGTCCAAAAAATCA primers (Hebert et al., 2004) were used for the PCR amplification of mtDNA COI gene. Cycling parameters for PCR amplifications were as follows: Initial denaturation at 94°C for 2 min, 5 cycles of 94°C for 30 sec, annealing at 45°C for 40 sec, and extension at 72°C for 1 min, 35 cycles of 94°C for 30 sec, annealing at 51°C for 40 sec, and extension at 72°C for 1 min, final extension at 72°C for 10 min Hold at 4°C. PCR products were electrophoresed in 1.0% TAE agarose gels, stained with GelRed, and visualized under UV light.

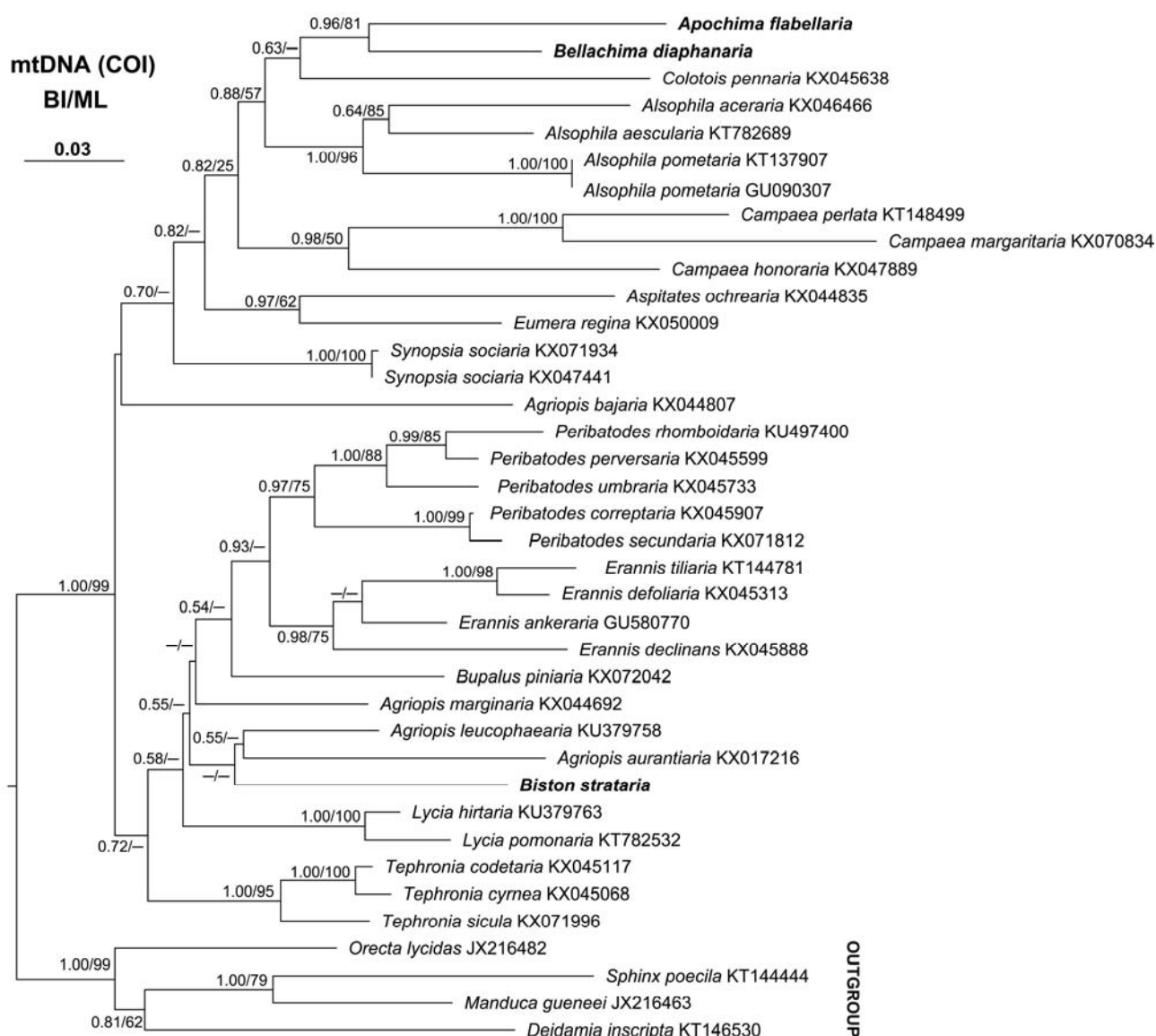
The PCR products were sent to Macrogen (Netherlands) for the purification and sequencing. Purified PCR products sequenced bi-directionally with LepF1 and LepR1 primers for each specimen. Obtained the sequences were aligned by CodonCode Aligner Programs and its quality was checked and consensus sequences were obtained about 670 base pair. The full length lepidopteran DNA barcode sequence is a 658 base pair long segment of the 5' terminus of the mitochondrial COI gene so the excess ends of obtained sequences were trimmed manually. Other sequences used in the present analyses were obtained from the GenBank database by MEGA 7. The mtDNA COI gene sequences were aligned using Clustal W implemented in MEGA 7 with default parameters (Kumar et al., 2016). FASTA formed sequences were transformed to nexus and ML files

on ALTER online program. Maximum-likelihood (ML) analyses were carried out online on the CIPRES Science Gateway CIPRES Portals: [http://www.phylo.org/sub\\_sections/portal](http://www.phylo.org/sub_sections/portal) with RAXML-HPC BlackBox (7.2.7). The reliability of internal branches was estimated by bootstrapping with 1000 replicates.

The program JModeltest v.2.1.7 (Posada 2008) selected GTR+I+G as the most suitable evolutionary model according to the AIC criterion for Bayesian inference. A Bayesian inference (BI) analysis was performed with MrBayes ver.3.2.6 (Ronquist & Huelsenbeck, 2003) using the Markov chain Monte Carlo algorithm. BI analyses were run for 3,000,000 generations and tree sampling every 100 generations. The posterior probabilities were then obtained and a majority-rule consensus tree was generated from the remaining trees after discarding the first 25% of samples.

### Phylogenetic analyses

The newly characterized mtCOI sequences have been deposited in GenBank with the GC content.<sup>4</sup> *Bellachima diaphanaria* 28.26%, *Apochima flabellaria* 30.09%, and *Biston strataria* 29.78%.



**Fig. 1.** Maximum Likelihood tree constructed by mtCOI gene sequences. Sequences investigated in the present study are in bold. Numbers on branches are the following: Numbers given at nodes of branches are the posterior probability (BI) and bootstrap (ML) values, respectively. Dashes (-) reflect the disagreement between BI and ML. The scale bar corresponds to 3 substitutions per 100 nucleotide positions.

<sup>4</sup> GenBank accession numbers are expected.



Our sequences based on molecular characterization of the mtDNA COI partial gene provided the first records of *Apochima*, *Bellachima* and *Biston* in East Turkey. Phylogenetic inferences based on two analyses (ML and BI) reconstructed the similar topologies for COI, therefore the topology of the ML tree is shown with support values from both algorithms on branches. There was separation into two major clades with very strong supporting values (ML/BI, 99% and 1.00) (Fig.1). *Bellachima diaphanaria* was clustered as a sister to *Apochima flabellaria* with strong bootstrap support (81%) and posterior probability value (0.96), while *Biston strataria* was clustered into other clad with relatively low supporting values in ML and BI trees (Fig.1). In phylogenetic tree, *Bellachima diaphanaria* and *Apochima flabellaria* were closely related the members of genera *Colotois* and *Alsophila*, while *Biston* was closely related to *Agriopis*. However, the members of *Agriopis* separated into polyphyletic clusters (Fig.1).

## Discussion

The morphological evidences and molecular analysis clearly indicate and confirm that *diaphanaria* should be considered under a generic taxon different from *Apochima*. Therefore, a new genus, *Bellachima* is established here. Our molecular analyses also suggest that there is a large variation between new genus and other related genera of tribe *Ennominae*. Our morphological researches showed significant differences regarding external and internal characters between the presented species. The phylogenetic trees based on COI have supported genetic distance between the presented populations concordant with morphological results. In some of the previous papers, it is stated that *Apochima* and *Biston* are considered close to each other morphologically (Meyrick, 1892). In the present time, *Apochima* is classified after *Biston* within the tribe *Bistonini* (Lepiforum, 2018). However, these genera are placed very far from each other in the phylogenetical tree based on mtCOI (Fig.1). This means that the morphological characters defined these genera appears not to be plesiomorphic.

There is a need for further detailed study using more molecular data to establish resolves belong to the members of *Biston*, *Apochima* and *Bellachima* obtained from different regions.

## ***Bellachima* gen. n.**

<http://zoobank.org/urn:lsid:zoobank.org:act:E5494502-E4D1-45F3-AD65-BEED57E848AF>

Type-species: *Zamacra diaphanaria* Püngeler, 1904, by present designation.

Description (Figs. 4, 5, 8, 9, 11, 13, 15, 16, 19, 20, 23, 24, 26, 27; Table 1, Map 1):

Secondary sexual dimorphism strongly developed. Frons with a  $\Delta$ -shaped, well chitinized projection. Under-eye-sclerites triangular. Antenna long, bipectinated in male, filiform in female. Wings triangular. Margin of hindwing undulated. In male fore-leg, epiphysis thin, very long, sinuous terminally, its aperture on tibia triangular. Terminal spurs on hind-tibia, almost equal, thin and longer, pointed terminally; median spurs rudimentar, very short and round terminally. Tympanal organ incompletely and asymmetrically developed. Male genitalia almost symmetrical. Uncus bilobed, elongated. Dorsal arm of valva well developed, strongly curved. Ventral arm of valva broad, partly well chitinized, outer part triangular shaped and membranous. Juxta almost rectangular, round basally. Saccus broad, round. Aedeagus large, tubular, slightly curved at both tips; a single cornutus, slightly curved, and as long as half of aedeagus. In female genitalia, papilla analis well developed. Anterior apophyses short, thick. Posterior apophyses remarkably elongated and thin. Anterior part of corpus bursae round, membranous, small, without signum. Posterior part of corpus bursae broad, elongated, and well chitinized. Ductus bursae membranous and short. Antrum long, tubular. Vaginal lamellae sclerotized, triangular in shape on sides.

This new genus differs from *Apochima* Agassiz by the shapes of projection of frons, vertex, under-eye-sclerites, the symmetrical male genitalia, position of uncus, well developed dorsal arm of valva, shape of ventral arm of valva, well developed cornutus in aedeagus, narrower abdominal basal segments, larger tympanal organ, undulated margin of hindwing.

When describing the species, *diaphanaria*, Püngeler (1904) mentioned the external characters only of the female. Similarly, Wehrli (1936) described male of *rjabovi* as a subspecies of *diaphanaria*. For that reason, re-description of the species is needed and given below:

*Bellachima diaphanaria* (Püngeler) (Figs. 4, 5, 8, 9, 11, 13, 15, 16, 19, 20, 24, 26):

Secondary sexual dimorphism strongly developed on antennae, wing markings and colourations. Head capsule: Covered by dense, long hairs externally. Frons with a  $\Lambda$ -shaped well chitinized projection. Hairs of lateral setae over compound eyes regularly developed. Under-eye-sclerites triangular. Antenna: Long, bipectinated in male, filiform in female. Wings: Triangular. Margin of hindwing undulated. In male, upperside dark cinnamon coloured. Creamy markings and darker spots often reduced. Ciliae slightly darker, not chequered. Underside similar to upperside. In female, creamy markings better developed on upperside of wings. Cinnamon colouration reduced. Brownish transversal bands irregularly developed. Dark coloured spots common and irregular on both wings. Ciliae chequered. Underside similar to upperside. Male fore-leg: Epiphysis thin, very long, sinuous terminally, its aperture on tibia triangular (Fig. 19). Hind-leg: Normally developed. Terminal spurs on tibia, almost equal, thin and longer, pointed terminally; median spurs rudimentar, very short and round terminally (Fig. 20). On both legs, tarsal segments carry minute spines in irregular rows. Claws well developed. Abdomen externally covered by long, soft hairs contrary to *flabellaria*. Tympanal organ (Figs.23, 24) incompletely and asymmetrically developed. Male genitalia (Fig.26) almost symmetrical. Uncus bilobed, elongated. Dorsal arm of valva well developed, strongly curved; its thickness irregular, round terminally. Ventral arm of valva broad, partly well chitinized, outer part triangular shaped and membranous. Juxta almost rectangular, round basally. Saccus broad, round. Aedeagus large, tubular, slightly curved at both tips; a single cornutus, slightly curved, and as long as half of aedeagus. Female genitalia (Fig.27): Papilla analis well developed. Anterior apophyses short, thick. Posterior apophyses remarkably elongated and thin. Anterior part of corpus bursae round, membranous, small, without signum. Posterior part of corpus bursae broad, elongated, and well chitinized. Ductus bursae membranous and short. Antrum long, tubular. Vaginal lamellae sclerotized, triangular in shape on the side.

Synopsis of the species discussed (\* denotes type-species. = denotes synonym)

***Apochima*** Agassiz, 1847

*flabellaria* (Heeger, 1838)\*

*juglansaria* Graeser, 1888

= *albofasciaria* Leech, 1891

*excavata* (Dyar, 1905)

*praeacutaria* Inoue, 1976

***Bellachima*** gen.n.

*diaphanaria* (Püngeler, 1904)\* (comb.n.)

ssp. *rjabovi* (Wehrli, 1936) (comb.n.)

Distribution (\* denotes new provincial record):

*Apochima flabellaria*: Southern Europe, Balkans, Caucasus, Middle East countries, Turkey, Ukraine, Iran, Turkmenistan (Ashkabad). In Turkey, the species is widely distributed. The recorded provinces are as follows: Adana (Pozantı), Antalya (Kemer), Balıkesir (Edremit), Çanakkale, Diyarbakır (Kulp), Eskişehir, Hatay (Akbes), İstanbul, Malatya, Manisa, Kahramanmaraş, Mardin, Muğla, Siirt (Baykan, Şirvan), Van (Tuşba, Bardakçı)\*, Batman (Sason, Kaşayla)\*.

*Bellachima diaphanaria*: Turkey: Bingöl (Yado)\*, Bitlis, Van, Hakkari (Yüksekova, Dağlıca)\*, Armenia, Iran, Turkmenistan (Ashkabad).

As faunistical results, *Apochima flabellaria* is reported here for the provinces, Van and Batman for the first time. Similarly, *Bellachima diaphanaria* is newly reported here for the provinces, Bingöl and Hakkari.

Material studied:

*Apochima flabellaria*: East Turkey, Van Prov.: Tuşba, Bardakçı Toki 1725m 16♂, M. Kemal & A.Koçak; Batman Prov.: Sason, Kaşayla 1070m (72Fa), 21 2 2018, 1♂, Y. Bozkurt (obs. via photo). GP2296♂, GP2881♂. LepDNA Ap001-Cesa.

*Bellachima diaphanaria*: Turkey: Bingöl Prov.: Yado 1350m (12Ac), 8 9 2007, 1♀, M.Kemal & A.Koçak leg.; Hakkari Prov.: Yüksekova, Dağlıca, 1515m 23 9 2017 2♂, 1505m 15-16 10 2017

5♂2♀, 1785m 17 10 2017 1♀, 1520m 20 10 2017 1♀, all H.Uçak leg. GP20♂HU, GP37♀HU, GP2871♂, GP2872♀, GP2880♂. LepDNA Apoo2-Cesa.

*Biston strataria*: Turkey, Bitlis Prov.: Tatvan, Tosunlu NW 1790m, 22 4 2017 1♂, M.Kemal & A.Koçak leg. LepDNA Bisto1-Cesa.

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**Figs. 2-5** - *Apochima flabellaria* head of male (top): frontal view (left), lateral view (right). *Bellachima diaphanaria* head of male (below): frontal view (left), lateral view (right). Marked with white arrows: Hairs on protruding structures on frons, hairs of lateral setae over compound eyes, and under-eye-sclerites.



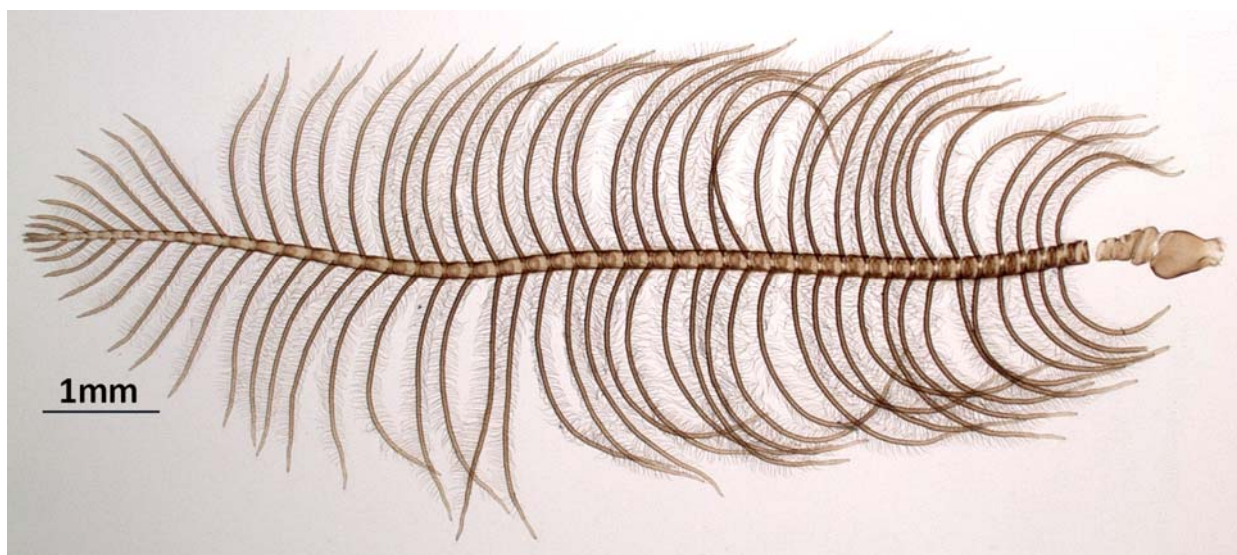
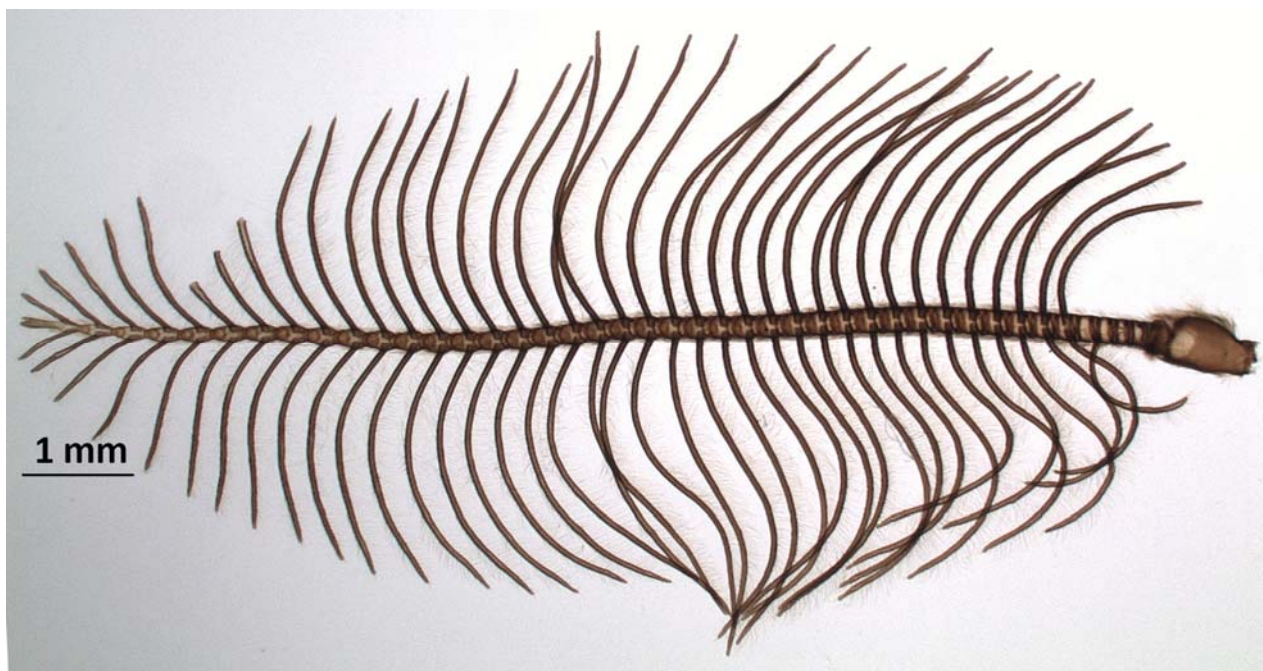


**Figs. 6-9** - Chitinous projections on frons and vertex: *Apochima flabellaria* (top), *Bellachima diaphanaria* (below). Frontal views (left), lateral views (right). Marked with white arrows: Locations of two humps on vertex, lateral view of vertex, protruding structures on frons, elongated at top forwardly and two lower points on edges, lateral view at top of protruding structure on frons.



**Figs. 10-11** - Apical part of male antennae. *Apochima flabellaria* (left), *Bellachima diaphanaria* (right). Both same sized.





**Figs. 12-13** – Male antenna (same sized): *Apochima flabellaria* (above), *Bellachima diaphanaria* (below).



**Figs. 14-16** - *Apochima flabellaria*: Male from Van Prov. Tuşba, Bardakçı (left), *Bellachima diaphanaria*: Male (middle), female (right), both from Hakkari Prov. Yüksekova, Dağlıca.





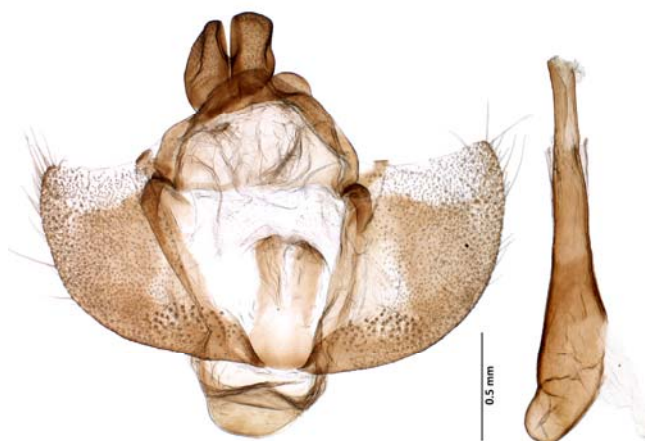
**Figs. 17-18** - *Apochima flabellaria* legs of male from Van Prov. Tuşba, Bardakçı: Foreleg with epiphysis, basal part enlarged (left), hindleg with a pair of spurs (enlarged) (right).



**Figs. 19-20** - *Bellachima diaphanaria* legs of male from Hakkari Prov. Dağlica: Foreleg with epiphysis, basal part enlarged (left), hindleg with two pairs of spurs (enlarged) (right).



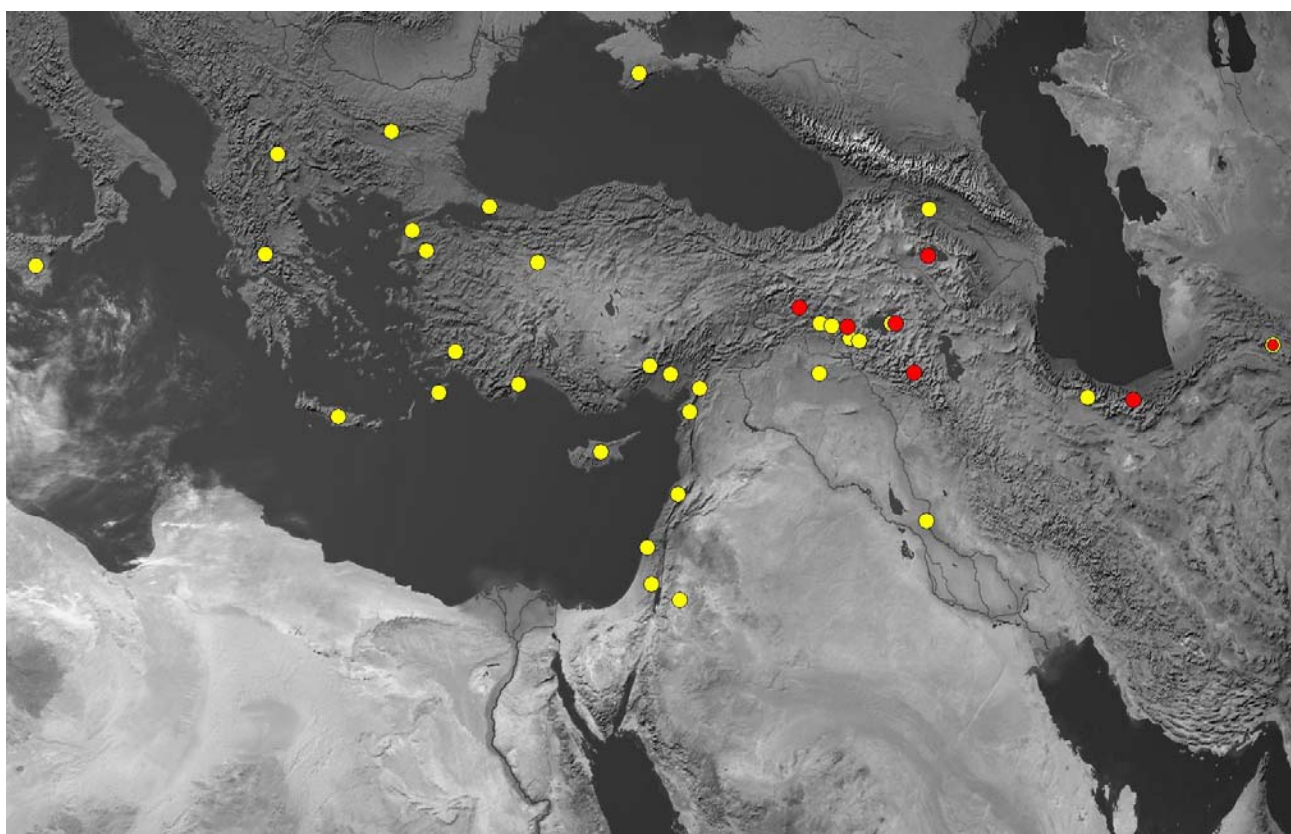
**Figs. 21-24** - Tympanal organs of *Apochima flabellaria* from Van Prov. Tuşba, Bardakçı (left), *Bellachima diaphanaria* from Hakkari Prov. Dağlica (right).



**Fig. 25** – *Apochima flabellaria* from Van Pr., Tuşba, Bardakçı: Male genitalia, aedeagus removed. GP2881.



**Figs. 26, 27** – *Bellachima diaphanaria* from Hakkari Prov., Dağlıca: Male genitalia, aedeagus removed. GP2880 (left); female genitalia GP2872 (right).



**Map 1** – Distribution of *Apochima* and *Bellachima* in the Middle East. Yellow: *Apochima flabellaria*; red: *Bellachima diaphanaria*. In Ashkabad (Turkmenistan) both species are sympatric.



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